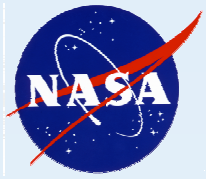


NASA GRC Icing Remote Sensing Activites

Andy Reehorst

Icing Branch, NASA Glenn Research Center

Outline

- Program philosophy
- Past key achievements
- Current activities

Program Philosophy

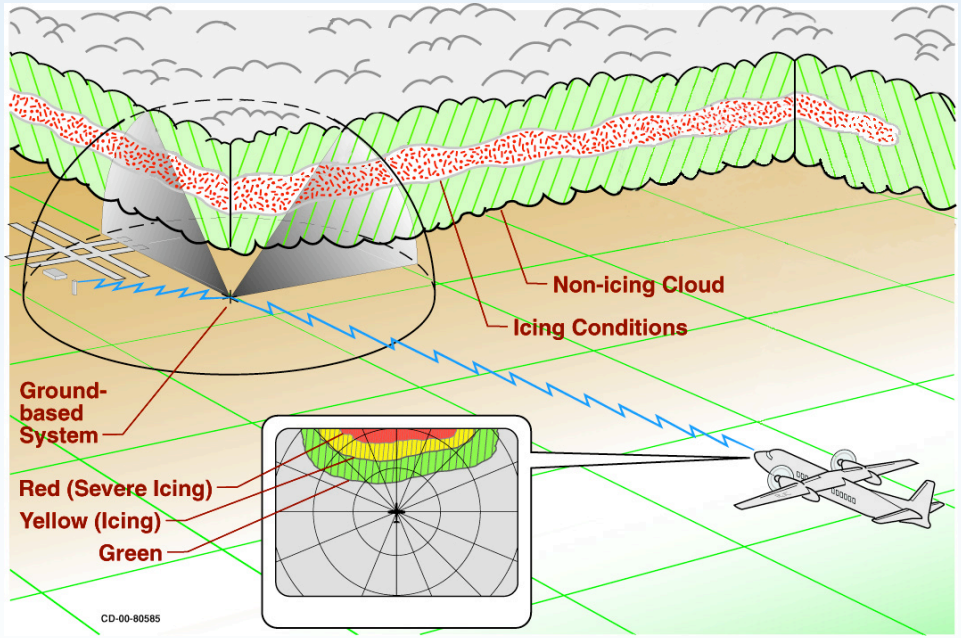
- Develop Remote Sensing Technology to improve icing-related flight safety
  - Enable tactical avoid and exit strategies
  - Improve strategic planning
  - Improve forecasts
- Fielded technology would aid flight-crews, airline dispatchers, air traffic controllers, and weather forecasters
- Focus on “low hanging fruit” for near term
  - Results in initially limited capability, ground based
- Later develop advanced ground based and airborne capabilities

Program Philosophy

- **Needed enabling technologies to remotely sense the presence of icing conditions aloft**
  - **Requires detection and measurement of liquid water**
  - **Requires measurement of temperature**
  - **Detection of exceedance conditions also requires measurement of droplet size**
- **Besides sensing technologies, development is required in**
  - **data encoding, severity characterization, data transmission (including up/down-linking), information display, and user training**

Program Philosophy

- Initially develop ground-based, vertical staring, terminal area sensing capability that can define altitudes with hazardous LWC/Temp
- Minimize cost, while providing relevant information
- Examine methods for information dissemination to aircraft
- Will also require future ground-based scanning capability to expand terminal coverage and airborne capability to provide coverage between airports



Past Achievements

- NASA hosted the 1997 Inflight Remote Sensing Icing Avoidance Workshop which provided the initial guidance for the US Government investments
- Building on the earlier Winter Icing and Storms Projects (WISPs), the 1999 Mt. Washington Icing Sensors Project (MWISP). NASA funded multi-frequency radar (UMass), radiometer (NOAA), and lidar (DREV), provided Twin Otter
- The 2000 joint US/Canadian Alliance Icing Research Study (AIRS) NASA funded radars (Umass and SPEC) and radiometers (SPEC), and aircraft (SPEC Lear) and provided Twin Otter
- NASA hosted November 2000 Inflight Icing Remote Sensing Workshop

Past Achievements

- Operated Profiling Radiometer at Lorain County Airport (LPR) from 1/19/01 to 3/23/01
- 16 Twin Otter Missed Approaches/Spirals
- 8 ATEK LWC sondes

Past Achievements

- Used field program data and Workshop feedback to develop Downselect Document
- Downselect Document defines three tiers of system:
  - Level 1, most inexpensive, least capable
    - Take profiling radiometer technology as far as possible
  - Level 2, intermediate cost and capability
    - Add Ka band cloud radar to profiling radiometer
  - Level 3, most expensive and capable
    - Combine polarized Ka band radar and profiling radiometer
- Level 1 and 2 being actively pursued by NASA (NOAA/FAA examining Level 3)
- Also recommend developing multi-band radar technology and airborne radiometry at lower funding levels for future use

Current Activites

- Initial system will use radar to detect cloud boundaries, multi-frequency microwave radiometer to measure total liquid water and temperature profile, and laser ceilometer to refine cloud base and temperature profile measurements

System being fielded this winter at AIRS II

- Radiometers
  - –Radiometrics WVP/TP 3000 and 89/150 GHz system
- Radar
  - –TSC/Honeywell X-band vertical pointing radar
- Ceilometer
  - –Vaisala CT-25K

Current Activities

Concurrent work in:

- **Information requirements and dissemination methods (MIT)**
- **Icing measurement and classification algorithm development (NCAR)**
- **Airborne radiometry (CRREL)**
- **Airborne 3-band radar (ProSensing)**
- **Airborne lidar (Innovative Dynamics)**

Current Activities

- **Ka-band radar procurement**
  - **METEK MIRA-36, vertical pointing Ka band radar**
  - Peak Power: 30 kW
  - Sensitivity: -48 dBZ (at 5 km range, 30 m resolution, 10 sec averaging)
  - Maximum Range: 15 km
  - Minimum Range: 180 m
  - Number of range gates: 500
  - Doppler velocity resolution: 5 cm/sec